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HELOPHORUS ARCTICUS BROWN, A LIVING FOSSIL (COLEOPTERA).

BY A. D'ORCHYMONT AND W. J. BROWN*

Helophorus arcticus Brown was described (1937, Can. Ent., LXIX, 109) from a single specimen taken by the describer in August, 1935, at Lake Harbour, Baffin Island, which is situated on the north shore of Hudson Strait at latitude 62° 50', longitude 69° 52'. The specimen was found beneath an old caribou horn resting on moss a few feet from the seashore. An extensive search failed to reveal more specimens of this singular beetle. However, Brown found the species again in 1937 at Churchill, Manitoba, situated on the western coast of Hudson Bay at latitude 58° 46', longitude 94° 10'. Between June 16 and August 19, fifty-eight specimens were taken. The specimens were found only near the grain elevator on the shores of a small bay where they occurred with species of *Bembidion* and *Simplocaria* beneath stones on damp soil. While all specimens were collected near salt water, it is not possible to state at present whether or not *arcticus* is restricted to such situations.

The type specimen of *arcticus* was described as a black beetle with a length of 3.3 mm. and with eight segments in each antenna. Churchill specimens are usually very dark brown rather than black, measure from 3.3 to 4.2 mm., and have either eight or nine segments in each antenna. Study of twenty of the latter shows both antennae to be nine-segmented in thirteen of the specimens (formula: 6 plus 3). In some of these, the suture between the fourth and fifth segments is not well developed. In the remaining specimens this suture disappears, so that in six specimens there are evident nine segments in one antenna and eight in the other (formula: 5 plus 3). In a single specimen, both antennae are of eight segments. A similar condition has been noted by d'Orchymont in some North American specimens of the subgenus *Helophorus s. str.* (1929, Bull. Ann. Soc. Ent. Belg., LXIX, 88). The entire surface of *arcticus*, except for the appendages, is always covered with a clay-like coating that usually obscures all structure except the elytral vestiture.

The characteristics of *arcticus* are so composite that at first it seems somewhat difficult to classify the species. The absence of a short, supplementary, juxta-scutellar row of punctures on each elytron and the symmetrical terminal segment of each maxillary palpus would tend to place it in *Atracthelophorus*, one of the second group of subgenera of *Helophorus*. But the pseudepipleural region is formed as in the subgenus *Gephelophorus* of the first group of subgenera which is characterized by the possession of a juxta-scutellar row of punctures. Indeed, the eleventh or external interval of the elytron (the interval external to the tenth complete stria) is strongly and longitudinally carinate as in *Gephelophorus*. The carina does not extend posteriorly quite as far as in *H.* (*Cyphelophorus*) *tuberculatus* Gyll. and simulates, when viewed from above, the margin of the elytron. The region external to this false margin, the pseudepipleuron, is neither visible from above nor horizontal, but is obliquely inflexed towards the true epipleuron as in *Gephelophorus;* it is gradually narrowed towards its apex and disappears completely where the carina of the eleventh interval terminates. Finally, the vestiture of the entire dorsal surface (head, pronotum,

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and elytra) consists of very distinct, stiff, curved setae, and this definitely removes *arcticus* from *Helophorus s. str.* and *Atracthelophorus* which comprise the second group of subgenera.

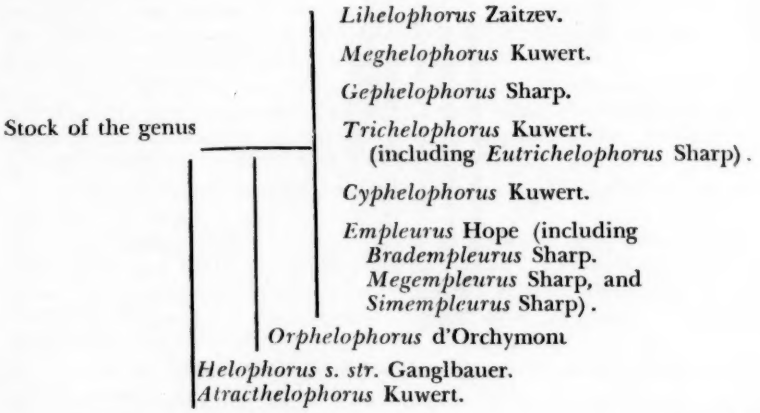
Study reveals that the overlapping characters noted above, including that of the vestiture, are also those of the subgenus *Orphelophorus* d'Orchymont to which *arcticus* must be referred. *Orphelophorus* was proposed for an extinct Pleistocene species, *wandereri* d'Orchymont, found in diluvial clay deposits of the second glacial period at Gostritz, near Dresden, Germany (1927, Sitz. Ber. u. Abhandl. Ges. Isis Dresden 1926, 103, 3 fig.). The type material of *wandereri* consists of two very well preserved elytra in which the alternate intervals are much more strongly elevated than in *arcticus*, being conspicuously but not sharply carinate. The European and the American species are certainly distinct.

Fig. 1. Distribution of *Helophorus (Orphelophorus) arcticus* Brown.

Of course nothing is known of the other body parts of *wandereri*, but this is of secondary importance in so far as subgeneric classification is concerned. The subgenera of *Helophorus* are defined, chiefly, by elytral morphology. The pronotal sculpture of *arcticus* is most unusual, but at least one example is known, in *H.* (*Atracthelophorus*) *singularis* Miller of the western part of the Balkan Peninsula, in which the granulation of the pronotum is very different from that observed in allied species. In *arcticus* the submedian and subexternal pronotal grooves are entirely lacking. Whether this is a palingenetic or cenogenetic feature is most difficult to decide. However, in some specimens, sometimes on one side only, high magnification reveals very narrow, rectilinear, unsculptured spaces on the areas these grooves should occupy. So it would seem that the pronotal sculpture of *arcticus* has been acquired secondarily. It may be noted, too, that in the Thibetan *H.* (*Lihelophorus*) *lamicola* Zaitzev, the sulci of the pronotum are nearly effaced, whereas in the very closely allied *ser* Zaitzev, the sulci are persent but very shallow.

As to the absence of the short, juxta-scutellar series of elytral punctures, d'Orchymont has explained previously how these might be lost cenogenetically (1926, Ann. Soc. Linn., Lyon, LXXII, 113). The fact that the strongly characterized *Orphelophorus* lacks these punctures seems to indicate that this simplifying process occurred at least twice during the differentiation of *Helophorus*.

In any case, however, the discovery of a second species of this subgenus known previously only from a fossil species confirms two things. First, *Orphelophorus* is a connecting link, reducing to some extent the gap existing between the two great divisions, that with and that without the juxtascutellar series, of the otherwise homogenous genus *Helophorus*. Second, it is not proper to divide *Helophorus* into several restricted genera as was done by Sharp; these restricted groups are only subgenera the phylogenetic relationship of which can be schematized as follows:



All of these subgenera except *Atracthelophorus* and *Helophorus* are poor in species. The latter is highly polyspecific and widely distributed, occurring in nearly all of the holarctic region, as far south as Mexico in America, and even in some mountainous regions of eastern Africa.

The arctic subgenus *Orphelophorus*, apparently extinct in Europe for a considerable period of geological time, survives in northeastern Canada in the very interesting species *arcticus*. Thus we can consider *arcticus* as sort of a "living fossil"! As the two stations at which specimens have been taken are separated by a distance of more than 1400 kilometers, the actual area of distribution seems very great. However, *arcticus* is probably restricted to the vicinity of the sixty degree parallel. Here climatic conditions similar to those of the pleistocene glacial periods still prevail. It seems probable that this species is one of the elements of the circumpolar fauna of glacial times, that it was able to follow the ice in its retreat to the north, and that where conditions are favorable it has suvived to the present day. *H. wandereri* was less fortunate. *Orphelophorus*, with its two geographically and chronologically remote species, is not as unusual in this regard as it may seem. The allied subgenus *Cyphelophorus* is truly circumpolar, occurring in the northern parts of North America, Europe, and Asia, and is even more homogeneous, including only one species, *tuberculatus* Gyll.

Can *arcticus* be also an inhabitant of the southwestern coast of Greenland which attains the sixty degree parallel and which has some insect species in common with Labrador and arctic America? The very poor fauna of that great island has been studied by several investigators, and their papers, principally that of Henriksen and Lundbeck (1917, Landarthropoder, Meddelelser om Groenland, XXII, 483-822) as well as several published since, do not list a

single species of the Palpicornia. It seems very questionable that *arcticus* would range so far eastward, although some authors believe there must have been a refuge in southern Greenland during the Ice Age (see Reinig, 1937, Die Holarktis, ein Beitrag zur diluvialen und alluvialen Geschichte der Zirkumpolaren Faunen—und Florengebiete, Jena, p. 105). However, this hypothesis depends upon a shifting of the pole but the possibility of this shifting is not

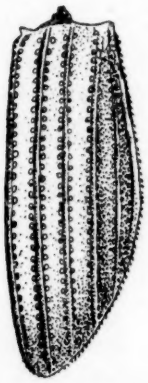


Fig. 2. Elytron of *Helophorus (Orphelophorous) wandereri* d'Orchymont.

accepted by others (see Klute, 1928, Zeitschrift fur Gletscherkunde, XVI, 88: also Woldstedt, 1929, Das Eiszeitalter, p. 361). The great width of Davis Strait and its unfavourable currents were and still are very serious obstacles to post-glacial migration from northern Canada eastwards. It seems even more improbable that migration occurred, under more favorable conditions of the past, across the narrow sounds farther north as has been suggested for some species by Jensen (1928, Groenlands Fauna, Copenhagen, p. 14; see also Degerboel, 1937, Meddelelser om Groenland, CIV, No. 19, 33).

ODONATA FROM THE PATRICIA PORTION OF THE KENORA DISTRICT OF ONTARIO WITH DESCRIPTION OF A NEW SPECIES OF LEUCORRHINIA

BY E. M. WALKER

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During the summer of 1938 the Royal Ontario Museum of Zoology, Toronto, organized an expedition to the little-known region of Favourable Lake, in the Patricia portion of the Kenora District, about 70 miles from the Manitoba boundary (53° 50' N. Lat., 93° 40' E. Long.). In 1939, two small parties were sent out by the Museum, one to Attawapiscat Lake, also in the Patricia country (52° 10' N. Lat., 88 E. Long.), and the other to various stations in the Cochrane District, from Cochrane northward to Moosonee on James Bay.

These expeditions were part of a general faunal survey of Ontario, which has been carried on by the Museum for many years. While the main object of the survey is the collection of birds and mammals for the purpose of obtaining accurate data on their distribution,attention is being given to other groups,

including insects, particularly such groups as are the subjects of special investigations by members of the staff.

The 1938 *Expedition.* The 1938 party consisted of Messrs. Clifford E. Hope and Leslie Prince of the Museum staff and G. Morley Neal, M. A., a graduate student in the Department of Biology, University of Toronto. Mr. Neal had charge of the invertebrates in general and kindly undertook to collect Odonata for the writer. In this part of his work he was ably assisted by Mr. Hope. Neither of these gentlemen had had previous experience in collecting dragonflies and the result of their efforts, a collection of nearly 700 specimens, representing twenty-eight species, is therefore remarkable, especially when the great variety of their other activities is taken into account.

The following notes on localities in the Favourable Lake region are based on information provided by Mr. Neal, to whom the writer is much indebted. More detailed accounts of the district will appear in the reports on other groups, which will be published by the Royal Ontario Museum.

The principal localities where collections were made on this expedition are the following:

Borthwick Lake. A typical bog or muskeg lake with water of rather high acidity, a floating margin, and the usual bog vegetation with an innermost zone of *Typha* and *Equisetum.* The average depth during the summer of 1938 was about three feet, after a drop of some two feet. There is a small outlet draining into Setting Net Creek.

Setting Net Creek. This is a small stream, the outlet of Setting Net Lake. There are five or six falls in a distance of about four miles of its course, and many rapids. The stream bed is rocky where the rapids occur but is muddy in the quiet intervals. Patches of *Sagittaria* are found on some of the quiet reaches.

Rat House Bay. A shallow, weedy arm of Sandy Lake, about ten miles long, bordered by open marsh. The water of this bay is apparently less acid than that of Borthwick Lake.

The camp site. The locality label of many of the specimens is "Favourable Lake", which Mr. Neal tells me does not refer to this lake in particular but to the region in general. Specimens so labelled were taken about the camp, which was situated at the Favourable Lake mine, but actually some miles from the lake of this name. Muskeg with numerous pools extended all the way from the camp site to Borthwick Lake, a distance of about a mile.

The 1939 *expedition.* Regarding this expedition we are mainly concerned with the party to Attawapiscat Lake, which, although also in the Patricia country, is nearly 200 miles farther east than Favourable Lake. This party consisted of Messrs. C. E. Hope, L. Prince and W. B. Scott. In spite of heavy work in collecting birds, mammals, fishes and miscellaneous invertebrate groups, Mr. Hope, assisted by Mr. Scott, collected 159 dragonflies representing nineteen species. They were reported to be far less plentiful than at Favourable Lake. Two additional species were taken by the other party, which collected at several localities on the Timiskaming and Northern Ontario Railway between Cochrane and James Bay. Nineteen specimens, representing eight species were taken by this party, chiefly by Mr. S. C. Downing and nearly all from Moosonee. A few were taken by Messrs. G. H. Clawson and M. A. Kirk. Although outside the territory covered by this paper, the species taken by this party are included for the sake of completeness, particularly as the localities of both parties lie in the same general latitude and same drainage basin. The difference in longitudinal distribution is of little significance.

The following notes are prepared from information kindly furnished by Mr. Hope.

Attawapiscat Lake is a large body of water, 24 miles long and four or five miles wide. It is really an expansion of the Attawapiscat River, which flows from it northward and eastward into James Bay. The country surrounding the lake is very low, there being no parts of the shore more than twenty or thirty feet above the water level. There are no exposures of bedrock but the lake shore is thickly bestrewn with boulders, pushed there by the force of expanding ice. Underlying the sphagnum moss which covers the ground there are glacial deposits of clay, which are exposed on burnt-over areas.

Except for the clearing on which the Hudson Bay Company post stands, and where the party made its headquarters, the country surrounding Attawapiscat Lake is largely covered with virgin forests, although there are burnt-over areas. Most of the timber consists of black and white spruce, the former occupying the lower lands, the latter the better-drained areas. Only about 10-13 per cent is composed of deciduous woods, such as poplar and birch.

Certain species of Odonata, such as *Lestes disjunctus,* inhabited the shallow bays of the main lake, where there was a considerable growth of *Equisetum,* while a larger number was taken at a relatively small bog lake, a few miles from the camp. Several species flew about the clearing, including a large number of *Somatochlora cingulata* which doubtless emerged from the main lake. The party had access to but few streams and practically no collecting of dragonflies was done at any of them, hence the paucity of records of stream species in the list from this locality.

LIST OF SPECIES

Calopteryx aequabilis hudsonica Hagen.

1938: Setting Net Creek, June 28, July 18-26, 5 ♂ 3 ♀.

1939: Moosonee, July 7, 1 ♀: Onakawana, Aug. 5, 1 ♀ (S. C. D.)

These specimens are typical of this race, which farther south grades into the race *aequabilis.* Two of the females from Setting Net Creek and the one from Onakawana have the wings almost as strongly marked as in the males, a condition never found, in my experience, in the race *aequabilis* but characteristic of the western race *yakima.* The remaining two females, however, have diffusely coloured wings, those of the one from Setting Net Creek being uniformly coloured, while the specimen from Moosonee has distinctly darkened apices. The same two colour phases, with some intergradation, are recognizable also among many females taken by the writer at Silver Island, north shore of Lake Superior. It thus appears that the females of *hudsonica* are dimorphic, the strongly banded form being the homoeochromatic phase, while the other form with concolorous wings represents the heterochromatic phase.

We have a few specimens of the race *hudsonica* also from the Kapiscau River, 180 miles from the mouth, taken by W. J. Wilson. This is also in the Patricia region and flows into James Bay south of the Attawapiscat River.

Mr. Neal reports having seen a *Calopteryx* on Setting Net Creek with the wings entirely black, which he failed to capture. The occurrence of *C. maculata* Beauv. as far north as Favourable Lake is not impossible but I have seen females of *aequabilis* with heavily suffused wings, which appear almost black when closed. I have twice seen what appeared to be *C. maculata* on the north shore of Lake Superior but have never been able to verify its occurrence there.

Lestes congener Hagen.

1939. Attawapiscat Lake, Aug. 13, 1 ♂, newly emerged.

This is the northernmost record of this species.

Lestes disjunctus Selys.

1938: Borthwick Lake, July 5-26: Setting Net Creek, July 18-20: North Wind Lake, Aug. 1: camp site, July 18- Aug. 6. 49 ♂ 23 ♀:

1939: Attawapiscat Lake, July 27, Aug. 1-17, 13 ♂ 5 ♀.

This species was evidently abundant in both localities. The majority

of the specimens were taken at Borthwick Lake. Juvenile specimens were taken from July 5 to 17 and a pair in copula on July 26.

Mr. Neal reports having observed in the Favourable Lake region a damselfly of dull brownish colour and an extremely long, slender abdomen, which rested with the wings half open. This description clearly applies to *Lestes rectangularis* Hagen, which was not expected so far north but has been taken by the writer at Minaki.

Enallagma boreale Selys.

1938: Borthwick Lake, June 11-24, July 9-26: Setting Net Creek, July 20: camp site, June 16, July 3-22: Aug. 6. 33 ♂, 8 ♀ in cop., others not separated from *E. cyathigerum*.

1939: Attawapiscat Lake, June 23, 24, 12 ♂ 5 ♀: July 6, 1 ♂ 1 ♀.

The specimens in general have the large robust form characteristic of northern latitudes. Of the 1938 series three pairs were taken in copula on July 6 and five pairs on July 9, 11, 13 and 26.

Eleven full-grown nymphs and two immature ones of this and possibly the next species were dredged from Borthwick Lake on June 9.

Enallagma cyathigerum (Charp.).

1938: Rat House Bay, June 11, 16: Setting Net Creek, July 18-21: North Wind Lake, Aug. 1: camp site, July 3-Aug. 6. 12 ♂ 5 ♀ in cop.

1939: Attawapiscat Lake, June 17, 1 ♂.

The specimens are of the same size and build as *E. boreale*. The majority, including all the copulating pairs, were taken in Rat House Bay, one pair on June 11, the other five pairs on June 16.

Thirty females of the two species combined were taken in all in 1938.

Agrion resolutum Hagen.

1938: Borthwick Lake, June 3-11, July 5-26: Setting Net Creek, July 18-21: Rat House Bay, June 16: camp site, June 3-27, July 3-10, 31 ♂, 17 ♀.

1939: Attawapiscat Lake, June 25-30, July 6, Aug. 1, 10 ♂ 5 ♀.

The 1938 series affords definite data on the time of emergence. Specimens taken on June 3 were all teneral, the majority just emerged: on June 11 and 13 they were still in part juveniles. After this date they were all mature. One copulating pair was taken on July 10. No specimens were taken in 1938 after July 26, but 1 ♂ was taken on Aug. 1 in 1939. The season of flight thus appears to begin only slightly later than it does in southern Ontario, where emergence begins about the third week in May. It is, however, somewhat shorter in the south.

One of the males from Borthwick Lake has the antehumeral stripes divided like an exclamation mark, a common variation in this species from the usually entire stripes. A few of the specimens from Attawapiscat Lake are unusually large and robust.

Agrion interrogatum Selys.

1938: Borthwick Lake, June 3, 1 ♂ 2 ♀, just emerged, July 5, 1 ♂ mature.

These are the first teneral specimens of this species that we have seen. The season evidently begins about the same time as that of *A. resolutum*.

This species is probably not so rare here as the above records suggest, but it seems to be almost everywhere more local than *A. resolutum* and is more definitely a muskeg species.

Nehalennia irene Hagen.

1938: Borthwick Lake, June 24, July 5-26, 8 ♂ 3 ♀.

Mr. Neal states that this species was not very common. It is one of the most widely distributed of Ontario Zygoptera but is much more abundant in the southern part of the province.

Basiaeschna janata (Say).

1938: Setting Net Creek, July 20-29, 2 ♂.

This is the northernmost record for this species. It was previously unknown north of Longuelac and Lake Nipigon (Walker '24).

Aeschna eremita Scudder.

1938: Borthwick Lake, June 18-24, July 4-6: South Trout Lake, June 14: Setting Net Creek, July 17-23: North Wind Lake, Aug. 1-2: Rat House Bay, July 20: camp site, July 2-28. 29 ♂ 18 ♀.

1939: Attawapiscat Lake, July 4-20, Aug. 5-12. 11 ♂ 5 ♀. Moosonee, July 18-20, 7 ♂ 1 ♀: Onakawana, Aug. 12, 1 ♀.

On the earliest of these dates, July 14, 1938, a single female was taken, which had just emerged. Emergence records for this species are very scanty, but we have repeatedly observed that it is fully mature before other species in the same locality have appeared. The great majority of the specimens in these series were taken in July. A full-grown nymph was taken from Borthwick Lake on June 9th.

This large *Aeschna* is a dominant dragonfly of the Canadian and Hudsonian zones from Atlantic to Pacific.

Aeschna interrupta Walker.

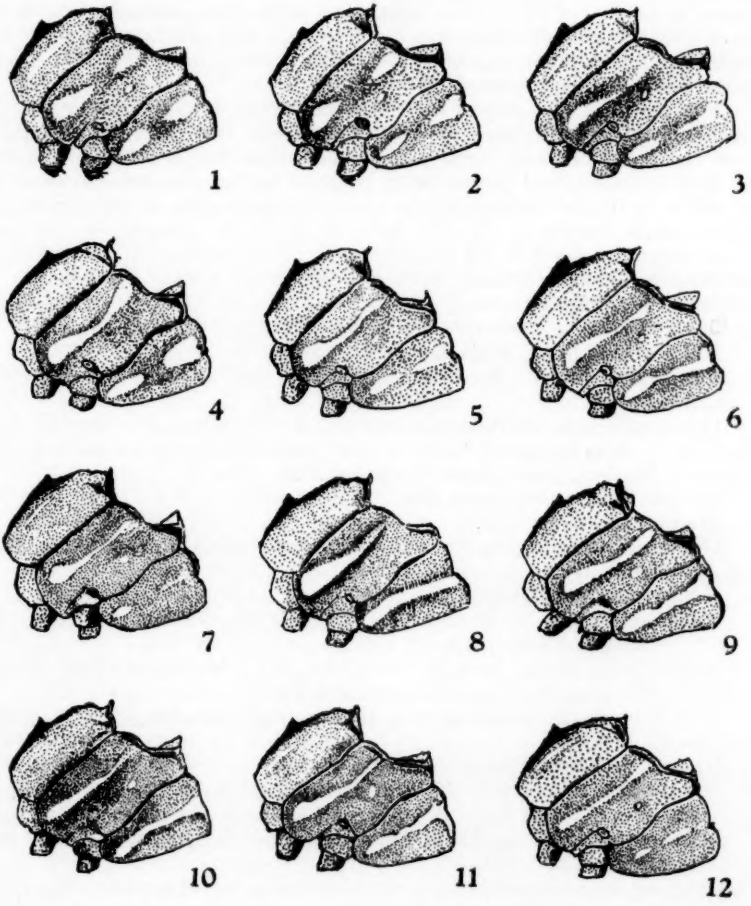
1938: Borthwick Lake, July 13-31: South Trout Lake, July 11-14: Setting Net Creek, July 17-27: North Wind Lake, Aug. 1-2: camp site, July 11-26, Aug. 8. 42 ♂ 65 ♀. Copulating pairs were taken on July 13, 28 and 31.

This is the first series of this species in which intergrades appear between the eastern race *interrupta* and the Central Plains race *lineata*. In the character of the pale lateral thoracic markings every gradation exists between the typical *interrupta*, in which there are two pairs of roundish spots on the sides of the thorax, to the typical *lineata*, in which these spots are replaced by linear streaks, usually entire but sometimes divided in the case of the metepimeral streak. There are other slight differences in the two races, particularly in the appendages of the female (Walker '12), which are generally shorter in *lineata*, and in the slightly more robust thorax and shorter abdomen in this race. These differences in proportions, however, are slight and unreliable, while those of the thoracic markings are remarkably constant over the greater part of the range of each race. The race *interrupta*, e. g., shows very little variation in this character from Nova Scotia to Lake Nipigon, Ont., the mesepimeral spots being constantly separate in the male and either narrowly separated or narrowly joined in the female. The race *lineata* is equally constant over a wide range, extending from eastern Manitoba to the Rocky Mountains.

The only exception to the above statements that has been hitherto recorded was the capture at Lake Abitibi in 1925 of two typical females of *lineata* among a number of typical *interrupta* (Walker '28). This fact, together with the constancy of the two races in general, threw some doubt on the question of their conspecificity. Nevertheless the occurrence west of the Great Plains of the races *interna* and *nevadensis*, which undoubtedly intergrade with *lineata* and with one another, and the appearance on the extreme west coast of a form closely resembling the eastern *interrupta* but merging into *nevadensis* pointed to the probability that, somewhere between Lakes Nipigon and Winnipeg, a region would be found where the two races would merge. Special instructions were therefore given to Mr. Neal to look for this species and to collect as many specimens as possible. In this endeavour he was successful beyond all our expectations.

The majority of the specimens are more or less intermediate between the two races. The mesepimeral stripe in some individuals is widened below as in *interrupta*, more or less narrowed above as in *lineata*, the two parts narrowly

PLATE I.



Aeschna interrupta Walk., left side of pterothorax, showing variations in the form of the pale lateral markings in individuals from the Favourable Lake region. Figs. 1 and 2 are typical of males of eastern race *interrupta*. Fig. 3 is also *interrupta* slightly approaching *lineata* in the elongation of the spots and the approximation of those representing the mesepimeral band. This is also chiefly but not exclusively a male pattern. Fig. 4 is a common female pattern in *interrupta*, seen also in some males from the Favourable Lake region. Figs. 5 and 6 are prevalent patterns in this region, intermediate between the two races and represented in both sexes. Fig. 7 is an intermediate type noted only among males. Figs. 8 and 9 show another intermediate female pattern which is indistinguishable from those of many females of the western races *interna* and *nevadensis*. Figs. 10 and 11 are from females and 12 from a male. They are practically typical *lineata*, especially 10 and 12.

connected or separated (pl. 1, figs. 1-12). The metepimeral marking is usually narrower below than in typical *interrupta*, wider than in *lineata*, and may be divided or entire. One or two females have the bands undivided but wider throughout than in *lineata*. Some of these intermediate females seem to be indistinguishable from those of the western races *interna* and *nevadensis*. There are other specimens of both sexes which are inseparable from Manitoba specimens of *lineata*, and still others which are entirely typical of eastern *interrupta*. In some of the pairs taken in copula the male is nearer *interrupta* than *lineata*, while the female is about typical of *lineata*.

The existence of a region in which the species is thus variable, between two much larger areas in each of which one of the two extremes of variation becomes the typical or only form present, points to the probability of genetic rather than environmental factors being involved in the complex. *A. interrupta interrupta* is doubtless confined to the forested regions east of the prairie provinces, but, while *lineata* is the only form found in the prairies, it also occurs quite unchanged in the forested country north of the prairies, e. g., at The Pas, Man. Both forms have recently been recorded from Alaska (Ahrens '39) but the Alaskan "*interrupta*" is doubtless the western race which is geographically independent of eastern *interrupta* and is not absolutely identical with it.

Aeschna canadensis Walker.

1938: Camp site, July 6: Borthwick Lake, July 26: North Wind Lake, Aug. 1, 2. 4 ♂.

This species was unexpected so far north. It is doubtless near its northern limit here. It is the common Aeschna of marshes and bogs in the Transition zone and the southern parts of the Canadian zone.

Aeschna juncea americana Bart.

1939: Moosonee, July 18, 1 ♂.

This Hudsonian species has not yet been found in Patricia but undoubtedly occurs there.

Aeschna sitchensis Hagen.

1938: Camp site, June 25: Borthwick Lake, July 13: Setting Net Creek, July 23: North Wind Lake, Aug. 2. 1 ♂ 3 ♀.

1939: Attawapiscat Lake, June 29, Aug. 3-4, 3 ♂: Moosonee, July 27, 1 ♂; Fraserdale, June 26, 1 ♀. (Clawson and Kirk).

A Hudsonian species of muskegs but sparingly distributed through most of the Canadian zone.

Aeschna umbrosa Walker.

1938: Setting Net Creek, July 23, 27: North Wind Lake, Aug. 2: Borthwick Lake, Aug. 4. 10 ♂ 3 ♀. A full-grown nymph was taken by the party while seining in the rapids at Rat House Bay on July 20.

1939: Attawapiscat Lake, July 27, 1 ♀.

These are the most northerly records in Ontario for this widely distributed species but, since it has been found in Labrador and Yukon Territory, it was not unexpected.

Ophiogomphus colubrinus Selys.

1938: Setting Net Creek, July 17-23: North Wind Lake, Aug. 1, 2. 14 ♂ 11 ♀.

Most of the specimens were taken while flying over Setting Net Creek. Two pairs were taken in copula at North Wind Lake. A nymph due to emerge next year was taken in the rapids in Setting Net Creek, July 28.

While this is the most northerly gomphid in Ontario, there are others which may be expected at the latitude of Favourable Lake.

Cordulia shurtleffi Scudder.

1938: Borthwick Lake, June 3-8, July 11: camp site, June 2-28, July 4, 6: Rat House Bay, June 16. 20 ♂ 22 ♀.

1939: Attawapiscat Lake, June 24-30, July 5-6, 2 ♂ 6 ♀.

Specimens taken on June 2 and 3, 1938, were newly emerged or very teneral and juvenile specimens were taken until June 16. The range of dates indicates a season nearly as early as it is in southern Ontario, where this species occurs only locally.

C. shurtleffi is typical of the Canadian zone across the continent and is, as yet, unknown from the Hudsonian zone.

Somatochlora minor Calvert.

1938: Setting Net Creek, July 17-21, 1 ♂ 1 ♀.

1939: Attawapiscat Lake, June 24, 1 ♀, teneral.

A species of both Hudsonian and Canadian zones, from the maritime provinces to British Columbia.

Somatochlora franklini Selys.

1938: Camp site, June 22-27, 2 ♂, July 3, 4, 2 ♀.

1939: Attawapiscat Lake, June 25-30, July 4, 2 ♂ 6 ♀.

A species of the Hudsonian and cooler parts of the Canadian zone, generally common at the latitudes of Favourable and Attawapiscat Lakes. The specimens taken in 1938 are all more or less teneral.

Somatochlora hudsonica (Hagen).

1938: Camp site, June 27, 1 ♀.

1938: Attawapiscat Lake, June 30, July 4. 2 ♀.

The known range of this species is in the Hudsonian and cooler parts of the Canadian zones from Hudson Bay to Yukon Territory and southward in the Cordillera through Alberta and British Columbia to Colorado. It will very probably prove to be transcontinental.

Somatochlora albicincta (Burm.)

1939: Attawapiscat Lake: Aug. 5, 1 ♀.

A common Hudsonian species across the continent, which occurs also locally in the Canadian zone.

Somatochlora cingulata Selys.

1938: Camp site, June 28, 1 ♂: Setting Net Creek, July 17, 1 ♀.

1939: Attawapiscat Lake, June 25-30, July 4, Aug. 10, 15 ♂ 31 ♀.

This large, robust *Somatochlora* was evidently abundant at Attawapiscat Lake. The only specimen taken on June 24 is a newly emerged female. Numerous specimens taken on the following day are all juvenile. They were flying in the clearing and about the lake shore. They had doubtless emerged from the main lake.

S. cingulata is a dominant species of the northern parts of the Canadian zone and extends into the Hudsonian.

Tetragoneuria spinigera Selys.

This species is not represented in the collections but is recorded from Patricia on the basis of a female from Nighthawk Lake taken in July, 1930, by Dr. A. J. Laird. It is larger than the average but smaller than specimens from the Thunder Bay District.

Libellula quadrimaculata L.

1938: Borthwick Lake, June 24: camp site, June 24-30, July 3-22. 20 ♂ 4 ♀.

1939: Attawapiscat Lake: July 5, 1 ♀: Moosonee, July 18, 1 ♂.

This circumpolar dragonfly is one of the most widely distributed of Canadian Odonata, being found throughout the Canadian and Transition zones into the Upper Austral and evidently reaching at least the edge of the Hudsonian.

Sympetrum obtrusum (Hagen).

1938: South Trout Lake, July 14: Setting Net Creek, July 17-28, Aug. 4: Borthwick Lake, July 23-31, Aug. 6: camp site, July 29, Aug. 6: North Wind Lake, Aug. 1, 2. 55 ♂ 17 ♀.

Specimens taken on July 22 were mostly teneral, including one just emerged. Emergence apparently takes place about the same time as it does in southern Ontario.

It is somewhat surprising to find this the common *Sympetrum* of the Favourable Lake region. Most northern collections show a great preponderance of *S. decisum*. We have observed, however, that in middle and southern Ontario *S. obtrusum* is commonly the only species in waters of high acidity and this is probably also true in the north.

Sympetrum decisum (Hagen).

1938: Borthwick Lake, July 31, 1 ♂; Aug. 6, 1 ♀, both specimens teneral.

1939: Attawapiscat Lake, Aug. 18, 1 ♀: Moosonee, July 21, 3 ♀, newly emerged.

In southern Ontario this insect usually emerges late in June or early in July, although there is much irregularity with regard to this period.

Specimens from the latitude of Moosonee are generally smaller than average individuals from southern Ontario. A single mature female from Attawapiscat Lake has deeply flavescent wings, a feature not seen in southern specimens but common northward and westward.

Sympetrum danae Sulzer.

1938: Borthwick Lake, July 31, 1 ♂: Aug. 6, 1 ♀, both specimens teneral.

1939: Attawapiscat Lake: Aug. 16, 1 ♂.

This circuupolar species should be common at these latitudes. It is characteristic of the Canadian zone.

Leucorrhinia borealis Hagen.

1938: Camp site, June 24, 28. 4 ♂ 1 ♀.

This is the first record of this large species from Ontario, although it was expected in this section of the province on account of its abundance in northern Manitoba. It is characteristic of the northern parts of the Great Plains and ranges into northern British Columbia (Walker '27) and Alaska (Ahrens '38). It appears to be a very early species, having been fully mature when the party arrived at camp. Mr. Neal states that it was plentiful but difficult to net over the water. Its season of flight was apparently over long before that of the other Leucorrhinias.

Leucorrhinia hudsonica (Selys.).

1938: Camp site, June 2-27: Borthwick Lake, June 3-28: Rat House Bay, June 16: Setting Net Creek, July 30, 28 ♂ 21 ♀.

1939: Attawapiscat Lake, June 21-30, July 1-5. 7 ♂ 6 ♀.

The great majority of the 1938 specimens were taken at Borthwick Lake. Those taken on June 2 and 3 are tenerals, some just emerged. Only a single specimen, a male, was taken on July 20th; all the others from this locality in June.

Widely distributed from Labrador to Alaska in both the Canadian and Hudsonian zones, this is the commonest *Leucorrhinia* at the latitude of Favourable and Attawapiscat Lakes.

Leucorrhinia patricia n. sp. (Plate 2).

Nearly related to *L. hudsonica,* of similar size but with a much more slender abdomen, which lacks the yellow spots posterior to segment 3.

Occipital triangle and vertex black; clypeus and labrum creamy yellow (doubtless white in life), the postclypeus with a black lateral margin, the labrum with the free margin very narrowly black; labium and rear of head black, the latter with a small, yellow spot above the middle near the outer margin.

Prothorax black, anterior lobe with front margin yellow and middle lobe with a pair of median yellow spots, posterior lobe with a fringe of long brownish hairs. Pterothorax black, variegated with yellow spots as in *L. hudsonica.* Legs black. Wings hyaline, the dark brown basal spots as in *hudsonica,* i. e.,

a small spot in the subcostal space of each wing and a triangular spot in the cubital space, extending to anal area and much larger on hind wings than on front wings. Venation black with the following parts whitish: the antenodal veins of both series, nodus, edge of costal vein distal to nodus and a patch of veins distal to the pterostigma, including the costal vein and several of the parallel longitudinal veins behind it. Pterostigmata dark fuscous.

Abdomen of same length as in *hudsonica* but decidedly more slender (fig. 13), black with the yellow markings confined to the first three segments. Seg. 1 with small lateral spot; seg. 2 dorsally and laterally, except in front of transverse suture; 3 in front of transverse suture and a median dorsal extension of this area behind the suture and tapering to an acute apex. Intersegmental membranes following segs. 7, 8, and 9 pale brownish.

Accessory genitalia as in figs. 15, 17. Hamuli similar to those of *hudsonica* (figs. 14, 16) but with the inner branch a little shorter and more abruptly recurved, outer branch smaller, sharply recurved mesad and cephalad, its outer angle prominent but not produced into a definite process as in *hudsonica*. Genital lobes a little shorter than in *hudsonica*. Superior appendages (figs. 18, 19) about as long as seg. 9, slightly incurved, subequal; apices, viewed from above, directed caudal; in profile somewhat arched, slightly deepened distally with a rounded distal surface, bearing dorsally a sharp, slightly upturned, apical spine and ventrally a much more obtuse tooth, ventral surface with several minute denticles. Inferior appendage (fig. 20) two-thirds as long as the superiors, much broader than long, the lateral margins slightly convergent and convex, apical margin broadly obtusangularly excavate.

Venation as in *hudsonica;* sectors of arculus in front wings united for a longer distance than usual in *Leucorrhinia;* triangles of front wings crossed, the costal side scarcely three-fourths as long as the proximal side; triangles of hind wings free; no additional cubito-anal cross-veins. Antenodals, f. w. 7. 7, h. w. 5. 5, complete; postnodals, f. w. 7. 7, h. w. 7. 6; pterostigmata scarcely twice as long as broad, with anterior and posterior margins both somewhat convex.

Total length (mm.) 28.5, abd. 18, h. w. 20, pt. 1.6-1.7, sup. apps. 1.33.

Holotype ♂, Borthwick Lake, Kenora District, Ont.; June 24, 1938 (G. M. Neal), in Royal Ontario Museum of Zoology.

The specimen is somewhat teneral but the colours are fully developed. The head is somewhat crushed and its outline, as shown in the figure, is drawn from *L. hudsonica,* from which it is probably indistinguishable.

This species is nearest *hudsonica,* from which it differs not only in the characters already mentioned but also in the form of its anal appendages. In *hudsonica* the sup. apps. are similarly arched but the apical spine is not tilted up and the ventral denticles are more distinct. The inferior appendage of *hudsonica* has the lateral margin straighter and slightly divergent instead of convergent, the distal breadth being greater than the proximal.

Leucorrhinia glacialis Hagen.

1938: Borthwick Lake, June 18, July 13-26; camp site, June 28, July 3. 5 ♂, 3 ♀ in cop., other females not separated from *L. proxima.*

Pairs were taken on July 3rd, 16th and 26th, one on each date. All the specimens are mature. Two full-grown nymphs were taken from Borthwick Lake on June 7.

This is a generally distributed, transcontinental, boreal species, usually less common than the next species but sometimes locally more plentiful.

Leucorrhinea proxima Calvert.

1938: Borthwick Lake, June 18-26, July 9-26; camp site, June 24-27, July 22, Aug. 6; Setting Net Creek, July 17 22 ♂, 4 ♀ in cop.

1939: Attawapiscat Lake, June 24, 29, July 5. 1 ♂ 4 ♀.

PLATE II.

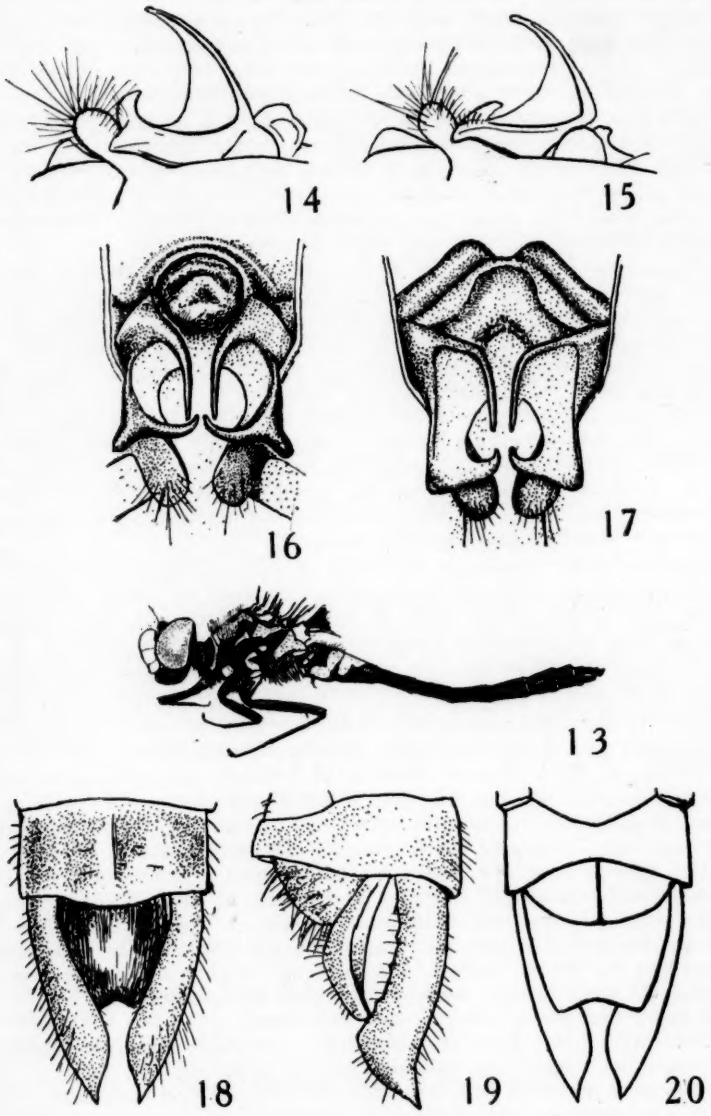


Fig. 13. *Leucorrhinia patricia*, ♂ holotype.
Fig. 14. *L. hudsonica*, ♂, profile of hamulus.
Fig. 15. *L. patricia*, ♂, profile of hamulus.
Fig. 16. *L. hudsonica*, ♂, ventral view of hamuli.
Fig. 17. *L. patricia*, ♂, ventral view of hamuli.
Fig. 18. *L. patricia*, ♂, appendages, dorsal view.
Fig. 19. *L. patricia* ♂, appendages, profile.
Fig. 20. *L. patricia*, ♂, appendages, ventral view.

Tenerals were taken on June 18 and 24, 1938, and June 24, 1939, but two males taken on the former date are mature. Four copulating pairs are dated June 20, July 9, July 26 and Aug. 6. The last pair are the only specimens taken in August. Eighteen full-grown nymphs were taken from Borthwick Lake on June 9.

This species has the same general range as *L. glacialis* but is generally found a little farther south.

Although the special characters of the male and those of the nymph are quite distinct, even suggesting different sections of the genus, no satisfactory diagnostic features have yet been found for the separation of the females, except in old examples, those of *glacialis* becoming slightly pruinose only ventrally, while in those of *proxima* the basal part of the abdomen is pruinose both dorsally and ventrally.

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NEW RECORDS AND NOTES OF ORTHOPTERA IN ONTARIO

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It is the purpose of this paper to add a few hitherto unreported species of Ontario Orthoptera to the list of those already recorded for the province. The majority of the species here recorded were taken by the junior author in Essex County in the extreme southwestern portion of the province of Ontario and are the result of an expedition sponsored by the Royal Ontario Museum of Zoology.

ENSIFERA

Gryllidae

Nemobius maculatus Blatchley.

Walker's record (1904) from Tobermory, Ontario, was based upon small specimens of *fasciatus*.

The only locality in Essex County where this species was found was a rather small but dense deciduous wood located four miles from the base of Point Pelee on the west side. Here they were found to be quite numerous. *Nemobius carolinus* was also fairly abundant in this wood, but whereas the latter seemed to prefer the more humid portions, *N. maculatus* was more abundant in the higher and drier sections. Unlike *N. carolinus*, this species did not seem to seek concealment beneath logs and other surface debris but crawled rapidly over the dry leaves, leaping a short distance in a rather zig-zag fashion at one's approach.

Point Pelee: Aug. 8, 7 ♂, 4 ♀, 4 nymphs; Sept. 8, 16 ♂, 18 ♀; Sept. 25, 6 ♂, 3 ♀; 1938.

Anaxipha exigua (Say).

That this small, marsh-inhabiting cricket has not previously been re-

corded from Ontario may be due, in part, to its rather unusual and sporadic appearance. Except for a single female specimen taken at Malden Centre, most of the specimens here recorded were taken by the junior author on one day in a small marsh located near the base of Point Pelee. At this time, forty-seven specimens were taken in a little over a half-hour's collecting. On returning to this locality a week later, only one female specimen was taken after three hours of collecting. The species was found inhabiting a dense growth of *Polygonum* (*P. lapathifolium*) which, at the time *A. exigua* was most abundant, was growing in over two feet of water.

Point Pelee: Sept. 8, 29 ♂, 18 ♀; Sept. 15, 1 ♀; 1938. Malden Centre: Aug. 12, 1938, 1 ♀.

Rhaphidophoridae

Tachycines asynamorus Adelung.

This adventive species, long referred to as *Diastrammena marmorata*, is apparently of Chinese or Manchurian origin. It has become fairly well established in greenhouses in various parts of Ontario.

Guelph: July 7, 1906, 1 ♀; Scarboro: Sept. 18, 1939, 2 ♀, A. Nielsen. Also reported from Toronto.

Tettigoniidae

Neoconocephalus lyristes Rehn & Hebard.

This species was recorded from Sarnia by Walker (1904) as *Conocephalus nebrascensis* Bruner, a closely related species from which, at that time, *C. lyristes* had not been separated. This matter was brought to our attention by Mr. E. S. Thomas to whom specimens were sent for study. We have confirmed Mr. Thomas' identification.

Conocephalus strictus Scudder.

It is rather surprising that this species has not been previously recorded, since it was by no means uncommon throughout Essex County, although not abundant in any one locality. Specimens were found by the junior author inhabiting rather dry, sandy pastures, usually in company with such species as *Melanoplus mexicanus*, *Melanoplus femur-rubrum*, *Conocephalus fasciatus* and *Gryllus assimilis*. Specimens were not taken in low-lying, humid land.

Point Pelee: July 24, 1 nymph; Aug. 3, 1 ♂; Aug. 6, 1 nymph; Aug. 12, 10 ♂, 2 ♀; Aug. 17, 2 ♂; Aug. 18, 1 ♂; Aug 28, 1 ♀; 1938.
Leamington: Sept. 15, 1938, 6 ♂, 2 ♀.
La Salle: Aug. 25, 1938, 7 ♂, 4 ♀, 1 nymph.
Kingsville: Aug. 25, 1938, 1 ♂, 2 nymphs.
Windsor: Aug. 27, 1938, 1 ♂.
Tecumseh: Aug. 27, 1938, 2 ♂, 1 ♀.
Staples: Aug. 27, 1938, 2 ♂.
Arner: Sept. 5, 1 ♂, 1 ♀; Aug. 12, 1 ♂, 1 ♀; 1938.
Windfall: Sept. 25, 1938, 3 ♂, 2 ♂.
Amherstburg: Aug. 25, 1938, 1 ♂.

CAELIFERA

Tridactylidae

Tridactylus minutus Sauss.

This tiny orthopteran was found in some numbers by the senior author on the sandy margins of a small stream in an open ravine near Morpeth, Ontario. It was associated with *T. apicialis* Sauss. The insects were captured by causing them to jump on to the surface of the water.

Morpeth: June 24, 1922, 18 specimens.

Acrididae

Pseudopomala brachyptera (Scudder).

Only one specimen of this interesting grasshopper was taken near Arner. It was found by the junior author in dense grass (*Calamagrostis canadensis*)

growing at the margin of a rather sluggish creek. An attempt was made to obtain further specimens by sweeping but without success, nor was it taken in the various other marsh areas throughout Essex County. From this we may infer that it is of rare occurrence and exists only in localities where protection is offered by surrounding hills or wooded areas remote from the lake shore.

Arner: Aug. 19, 1938, 1 ♀.

Arphia pseudonietana (Thomas).

This species was included by Walker (1902, 1909) in his list of the Acrididae of Ontario on the basis of Caulfield's record (1887) of *"Arphia tenebrosa"* from Nipigon and Sudbury. Its presence in Ontario was confirmed in 1935 by the senior author, who found it at Point Edward and Kincardine on the shore of Lake Huron. At Point Edward it was fairly abundant over a small area on the beach a little farther from the water than that where *Trimerotropis maritima interior* is most abundant, an area better covered with vegetation but nevertheless sparsely clothed with shrubs. The specimens from Kincardine were found on sand dunes adjacent to the beach. All the specimens are smaller than the average of specimens from the prairie provinces.

Point Edward: Aug. 15, 14 ♂, 4 ♀, 1935.

Kincardine: Aug. 18, 2 ♂, 2 ♀, 1935.

Arphia conspersa Scudder.

This species, which we have long expected from northwestern Ontario, was taken in the vicinity of Favourable Lake, in the Patricia portion of the Kenora District (52° 50' N. Lat., 93° 40' E. Long.) by Mr. C. E. Hope. The senior author recalls having seen a male of this species from Ottawa, taken by Mr. R. H. Ozburn, but has not been able to locate the specimen.

Favourable Lake: June 18, 1 ♂; June 27, 2 ♂, 1938.

Spharagemon collare Scudder.

On Aug. 18, 1935, the senior author found this species at Southampton, Bruce Co., on the beach of Lake Huron. It was common over a restricted area of the beach somewhat farther from the water than the zone where *T. maritima* was most abundant. This population consisted of individuals much larger than those already known for Ontario, and recorded as *S. collare wyomingianum* (Walker '01, '02). They have also proportionally larger and broader tegmina and appear to be more like the specimens we have collected in the western provinces, although the pronotal carina is somewhat higher. Two of the four individuals (♂ and ♀) are "collared", a type of colour-pattern not met with in a large series of the small form from the shore of Lake Erie. A male and female of the latter form were also taken by the senior author at Point Edward on Aug. 15, 1935. This locality is also on the shore of Lake Huron but is at the southern extremity, far south of Southampton where the large form of *collare* was taken. The specimens from Point Edward were taken with *Arphia pseudonietana* and *Trimerotropis maritima interior*.

The following table gives measurements of typical specimens from the four Ontario localities from which *S. collare* is known. As noted by the senior author in 1902 "specimens from Point Pelee average distinctly larger than from Rondeau". The two specimens from Point Edward were the only ones available from that locality.

	Rondeau L. Erie		Point Pelee L. Erie		Point Edward L. Huron		South-ampton L. Huron	
	♂	♀	♂	♀	♂	♀	♂	♀
Length to tip of tegmina	21.5	26.5	26.0	32.0	23.5	32.0	33.0	37.0
Tegmina	17.5	21.0	21.0	25.0	18.0	25.0	26.5	30.4
Hind femur	9.8	13.0	13.0	14.0	12.0	14.0	14.0	16.0

Melanoplus viridipes Walsh.

A small series of this short-winged grasshopper was taken by the senior author in an unpastured woodlot near Leamington, Essex County. Mr. E. S. Thomas, who has examined these specimens, states that they are about intermediate between *M. v. viridipes* and *M. v. eurycercus* Hebard. We have confirmed this opinion by comparison of this specimen with Hebard's figures (1939) of the male cerci.

Leamington: June 22, 1922, 4 ♂, 4 ♀.

Melanoplus stonei Rehn.

This species was recorded by the senior author (1915) under the name of *M. packardii* Scudd. from a pair taken *in coitu* near Fort William. Since then the senior author has taken it in several localities in Ontario and Quebec. It was found at Orient Bay, Lake Nipigon, in 1920, on a sandy spit that was becoming afforested with balsam poplar, a locality closely similar to one where the same grasshopper was found at Godbout, Quebec. A single male was found on July 14, 1929, on a low heath of blueberry and bearberry bushes adjoining the beach of Sandy Island, Lake Nipissing. The season was apparently just beginning. Finally we have found it on several occasions on the sand dunes adjoining the wide Wasaga Beach, Georgian Bay, where it is associated with *Trimerotropis huroniana* Walk., although it ranges some distance farther from the water. *M. stonei* is thus distinctly partial to sandy situations but is sometimes found far from water, as, e. g., at Godbout, Quebec, where we found it scattered over an extensive jack pine barren, as well as on the sandy, poplar-covered spit already mentioned.

Fort William: Aug. 2, 1910, 1 ♂, 1 ♀; Aug. 26, 1907, 1 ♀.

Orient Bay, Lake Nipigon: July 13 to July 25, 1920, 6 ♂, 3 ♀.

Sandy Island, Lake Nipissing: July 14, 1 ♂. 1929.

Wasaga Beach; July 30, 1937, 3 ♂, 1 ♀; Aug. 11, 1936, 4 ♂, 7 ♀; Aug. 15, 1932, 1 ♂.

Melanoplus differentialis (Thomas).

The range of this species as given by Blatchley (1920) extends from New Jersey and Pennsylvania north and west to Cheboygan County, Michigan, and Illinois, south and west through Tennessee to Mississippi and west of the Mississippi River from 45° north latitude as far west as the Pacific and south to southern Mexico. With this wide distribution in the United States its discovery in southern Ontario is not wholly surprising. It is, however, decidedly rare and local, only three specimens having been taken by the junior author, a female in a narrow strip of grassy land behind a barn at Point Pelee, and one of each sex taken *in coitu* at Colchester.

Point Pelee: Sept. 1, 1938, 1 ♀.

Colchester: Sept. 26, 1938, 1 ♂, 1 ♀.

Paroxya hoosieri Blatch.

This species was recorded from Arner, Essex County, by the senior author (1902, p. 252) as *Paroxya floridana* Thom. Specimens taken in the same locality by the junior author during the summer of 1938 were sent to Dr. James A. G. Rehn who compared the specimens with typical *P. hoosieri* from Blatchley.

Hebard (1934) considers *hoosieri* a distinct species and not a race of *clavuliger* as maintained by Blatchley (1920).

ACKNOWLEDGMENT

We wish to express our thanks to Dr. James A. G. Rehn of the Academy of Natural Sciences of Philadelphia for his assistance in the identification of doubtful specimens.

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BOOK NOTICES

Meadow and Pasture Insects. By Herbert Osborn, The Educators' Press Columbus, Ohio, 1939, pp. VIII + 288, 193 figs.

Constituting as it does the first broad general treatise of this widespread and abundant group, this book is an important addition to the literature, and in some respects an outstanding pioneering achievement. Not only does it bring together the more important available information bearing on this subject, but also—and perhaps in this lies its most valuable contribution—should markedly stimulate new work designed to fill the many gaps which exist in our knowledge of this difficult but technically and economically important field.

The historical account which introduces the discussion gains special authority from Dr. Osborn's long personal association with such studies, while added interest is given by the foreword of Dr. L. O. Howard. An able outline of the ecology of the meadow follows. Over three-fourths of the text is given to accounts of the species and groups which are of importance in grasslands. Of this, one chapter is devoted to animal groups other than insects, and eight chapters to the insects: Orthoptera, Thysanoptera, Homoptera, Heteroptera, Coleoptera, Lepidoptera, Diptera and Hymenoptera. The nature of losses from insects in grasslands is well indicated and a good general discussion given of control measures applicable to meadows and pastures. Economic aspects are also well brought out in the discussions for the major species and groups. The more than three hundred well-selected references (some of which are omitted from the bibliography) are a very valuable guide to the literature bearing on the subject. The omission is noted, however, of some of the excellent insect population studies that have been carried out, especially in British grasslands, by Barnes, Buckle, Edwards, Morris, Thompson and others; but full use is made of the data from the significant quantitative work of Wolcott in America. The index and table of contents afford an adequate guide to the material, while the well-chosen illustrations add to its usefulness.

Grasslands constitute the natural or climax community of some forty percent of the land surface of the world, including many of the most important agricultural regions. In addition, artificially maintained meadows and pastures make up a large and important proportion of the total agricultural land in other regions. It is truly astounding therefore that comparatively so little study has been devoted to the grassland fauna. In spite of their abundance and widespread occurrence, economic studies of grassland insects have been retarded, as Osborn points out, by several factors: the relative obscurity and constancy of the damage which they cause; the tendency to confuse such injury with the direct effects of weather and other uncontrollable factors; and a general assumption that little or nothing can, except in extreme instances, be done to control the insect hazard under these conditions. As the author brings

out, there is no *a priori* justification for any of these. Moreover, quite apart from their immediate practical bearing on the protection of meadows and pastures, thorough ecological studies are requisite, particularly in natural grassland areas, as affording the only sound basis for an understanding of climatic relations of the fauna and of the conditions governing the associated or related pests of cultivated crops.

The author points out that practical control measures for insect pests of meadows and pastures usually must be general in their application, in order to operate against as large a number as possible of the most abundant and destructive forms. This usually requires that such measures must be ecological either in character or basis. For this reason, the practical usefulness of the book, particularly to non-entomologists, would perhaps have been strengthened had it been possible to arrange the material in accordance with its ecological bearing rather than taxonomic relations, as the latter far too frequently brings together diverse forms and separates forms of similar relation to the ecological complex; an alternative would have been the inclusion of a section to correlate similar types of damage by different forms. Similarly, it might have proved helpful had the discussion been organized to conform more closely to natural regions, as the simultaneous treatment of the fauna of very diverse regions, except as it relates to broad governing principles, tends to diffuseness. It should be kept in mind however that not only are these criticisms comparatively minor, on the whole, but also that the first general treatment of a field that is so largely undeveloped can scarcely obviate them. This is particularly true, for example, of the apparent lack of balance as to the space allotted to the various species and groups, the determining factor usually being the amount of information available.

K. M. King.

Principles of Forest Entomology, By Samuel Alexander Graham, McGraw-Hill Book Cnmpany, New York and London. Price $4.00.

Dr. Graham's "Principles of Forest Entomology" differs radically from the majority of treatises on forest entomology by the nature of its approach to the subject. The average text book usually consist of a more or less extensive list of forest pests with descriptions, life-histories and recommendations for control measures. Undoubtedly, these have their rightful place in the literature and may be extremely valuable as reference works. Their usefulness, however, is largely delimited by the knowledge and experience previously acquired by the reader. Students, especially, are badly in need of orientation based on a thorough understanding of the complicated relationships existing in Nature and conditioning all rational control practice. Dr. Graham's work, true to its title is, above all, a clear, concise and up-to-date statement of this basic knowledge and, as such, is unique in the North American literature on forest entomology. The revised and enlarged second edition, although in most respects very similar to the first, presents some distinct improvements. "All interested in the protection of forests and forest products" to whom the book is dedicated, will welcome it with enthusiasm.

J. J. de Gryse.

CORRECTIONS

Scientific names were spelled incorrectly in two of the papers that appeared in the December number. A typographical error appeared in Dr. J. McDunnough's paper, "New Species of Geomeridae with Notes, II"; the name at the top of page 249 should read *Hydriomena albimontanata* n. sp., not "*Hydriomena albimonata* n. sp." In Mr. H. R. Boyce's paper, "A Note on Parasitism of the Leaf Miner, *Agromyza melampyga* Loew", on page 267, read *Pnigalio* throughout instead of "*Pnigalii*" and read *Diaulinus pulchripes* Cwfd., not "*Diaulences pulchryses* Cwfd.".

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